The Mysore Coffee Experiment Station—Bulletin No. 16

DEPARTMENT OF AGRICULTURE

MYSORE STATE

IMPERIAL MYCOLOGICAL INSTITUTE
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ANNUAL REPORT OF THE COFFEE SCIENTIFIC OFFICER, 1936-37

BY

W. WILSON MAYNE, B.Sc.,

Coffee Scientific Officer to the United Planters' Association of Southern India.

BANGALORE:
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FOREWORD.

As approved by the Executive Committee of the United Planters' Association of South India, this report is published as usual as a bulletin of the Mysore Coffee Experiment Station. Since the spraying of coffee has become an important agricultural operation, at any rate on large scale plantations, considerable statistical data have been presented by the Coffee Scientific Officer, on the effect of spraying. While statistical data obtained from experiments on a few plots in an area are not only difficult to interpret but may not prove to be of universal application to the entire coffee areas, an attempt has been made to draw tentative conclusions. Investigations were also taken up on a problem of considerable importance to the planter, namely, the quality of coffee in relation to fermentation. Some of the investigations of the Coffee Scientific Officer are however based on the work of the Mysore Department of Agriculture as for instance, the work of the Mycologist on the use of linseed oil, gingelly oil and molasses in spraying and of the Entomologist on the green-bug borer. I thank the officers of the department for their hearty co-operation with the work of the Coffee Scientific Officer.

T. G. RAMA IYER,
Director of Agriculture.

ANNUAL ADMINISTRATION REPORT OF THE COFFEE SCIENTIFIC OFFICER, 1936-37.

I have the honour to present the following report of work in progress during the year 1936-37, on problems connected with coffee. As usual, the report contains an account of the investigations in progress and general notes on coffee problems which have arisen during the year.

Work has been centred at the Mysore Government Coffee Experiment Station as in previous years. Co-operative work with the officers of the Department of Agriculture has been continued in connection with breeding, spraying and miscellaneous problems.

The Assistant continued work at Sidapur, Coorg, mainly concerned with the mode of infection of coffee roots by eelworms and with the control of borer with Tar Distillates.

The Biochemist appointed for work on the quality of coffee returned to the Chemical laboratories of the Mysore Department of Agriculture at the beginning of the year and has worked there during the year. His work is reported separately.

Touring.

Two visits were paid to Coorg in connection with work there and to examine progress of field experiments started in connection with borer control. The Annual General Meeting at Coonoor was attended in August and meetings of the Coorg Planters' Association and of the Mysore Planters' Association were addressed on aspects of the work on coffee problems in March.

Investigations.

Leaf Disease. Progress Report.—There is little of note to report from this investigation in the current year. The study of the behaviour of various families derived from known parents has been continued but no features of special note have been found.

Spray Materials and Methods.

Spray Mixtures.—In view of the conclusions reached last year with respect to the use of adhesives and spreaders, further work on this question was considerably curtailed. Observations were made only on the unsprayed plots, the Casein, Molasses and gingelly oil Bordeaux and plain Bordeaux plots. The results showed no special features. Owing to pressure of other work, the data are not yet available for publication.

Time and Strength of Spray.—The observations bearing on the time of application of the spray and the strength of mixture have been carried out as in previous years. As was noted last year, these observations are now maintained primarily for the study of the variation in disease intensity and degree of control of the disease in relation to climatic variations. The data for the current year show no special features. They were utilized in the preparation of a paper in the press at the end of the year and for that reason are not reproduced here.

Timing of the Hot Weather Spray.—In view of the comparative failure of the spray in some years and in view of certain conclusions detailed in the paper mentioned above, an experiment was laid out in the hot weather of 1936 to study the success of the spray in the hot weather in relation to the date of spraying.

Four plots were laid out and sprayed at different dates in April and May and in early October a series of observations were made to study the leaf survival and extent of infection in the four plots. The technique of observation differed from that used in earlier work in that separate records were made for cropping shoot and new non-cropping shoot. Full details of the method and the results are reserved for a separate publication. The following represents a short summary of the indications of the first year's results.

The first plot was sprayed 24 days after the blossom shower and the other three, 14, 28 and 42 days later respectively. In the case of the cropping shoots, the observations provided an estimate of the survival of leaves formed between the end of 1935 and the time of observation. In the case of the non-cropping shoots it was an estimate of the survival of the leaves formed between the blossom showers and the time of observation.

Taking the cropping shoots first, the percentage of leaf survival and the percentage infection of the surviving leaves are given in Table I.

TABLE I.

Percentage of Leaf Survival and Percentage Infection of Surviving Leaves in Plots Sprayed at Different Dates in the Hot Weather. (Cropping Shoots.)

	Date Sprayed. (In days after Blossom Shower.)			
	24	38	52	66
% Survival ...	61·9%	56·7%	52·6%	41·1%
% Infection ...	48·9%	56·1%	58·1%	41·1%

These figures indicate that on the whole the best results have been obtained from the earlier spray and that the control has been progressively poorer with later sprays. It must be borne in mind that the low percentage infection in the last plot does not indicate a lower leaf disease intensity but only that the elimination of diseased leaf has proceeded faster than the infection of the remainder. The figure for percentage infection must be considered in conjunction with the figure for leaf survival in data of this type.

Similar data for the non-cropping shoots are given in Table II.

TABLE II.

Percentage Leaf Survival and Percentage Infection of Remaining Leaves in Plots Sprayed at Different Dates in the Hot Weather. (Non-cropping shoots.)

	Date Sprayed (In days from Blossom Shower.)			
	24	38	52	66
% Survival ...	66·3%	72·3%	59%	62·8%
% Infection ...	66·0%	57·7%	56·1%	53·5%

The results for the non-cropping shoots show the same general tendency though much less marked than in the case of the cropping shoots. In this case the second spray, 38 days after the blossom shower, appears to have given the best result while the later sprays show a marked falling off in effectiveness as measured by the leaf survival.

The general conclusion from these data is that it is less important to attempt to cover the maximum leaf area

than it is to try to check the first stages of disease increase after the blossom showers. While these data require further confirmation from a repetition of similar observations, they are supported by conclusions reached from other observations dealt with in a paper at present in the press. A fuller treatment of this question will be found in that paper.

Studies of Fruit Setting and Fruit Development.

Crop Losses during Development.—Observations of the same type as those reported in previous years were carried out as previously. The data analysed as in 1935-36 are given in Table III.

TABLE III.

Distribution of Loss of Young Fruit.

	Per cent.
Loss up to and including visible size difference...	19·6
Unswollen fruit persisting	5·3
Loss six weeks following size differentiation ...	11·7
Loss in four following weeks	13·1
Later Loss (Aug. to Harvest)	1·4
Total ...	51·1
Flower bud originally present	6130.

The fruit set was good, being higher than in any previous year with the exception of 1935. The most notable features of the loss distribution are the low first loss and the rather high second loss which was as late with reference to the time of size differentiation as in 1936. The conventional period of six weeks after size differentiation which was satisfactory in 1932 and 1934 including all this loss was not so in 1935 (*Vide* report for 1935-36) and again in the present year. As in other years the loss in the last three months of fruit development was very small.

The study of the six years' data bearing on fruit set has been continued at intervals during the year. The mass of data accumulated is considerable and the analysis is still incomplete. The most striking feature so far noted is the close relation between the distribution of the hot weather growth and setting. Good set appears to be associated with rapid growth after the blossom showers

and an early slackening, whereas slow and continued growth after the showers appears to be associated with poor setting. There does not appear to be any close relation between the proportion of buds which set and the number of leaves present at blossom or the total amount of growth made by individual cropping shoots, in the growing season.

The Fruit Picked.—The fruits harvested were examined as in previous years for abnormalities. The data obtained are given in Table IV.

TABLE IV.

Analysis of Fruit Picked.

	1936	
Total Fruit	2,893	
Per cent Peaberry	13·4	per cent
Per cent 3 bean fruit	0·5	do
Total Beans	5,412	
Per cent empty beans	1·9	do
Per cent black beans	1·3	do

The figures call for little remark. Black beans were found to be slightly more common than in 1935 but were much less common than was anticipated as there was a heavy fall of leaf in August. In the present year the relation observed previously between the incidence of black bean and August leaf fall was not noted in the area in question. There were, however, complaints from several areas of losses from such bean defects.

The amount of ordinary empty beans was slightly less than in 1935, but differs little from the average for the past five years.

The amount of polyembryonic beans exceeded 1 per cent of the beans examined, being thus sensibly greater than in 1935.

The amount of peaberry fruit was considerably less than in 1935 but approximately the same as in 1934. The peaberry containing fruits appear to fluctuate between 12 and 20 per cent from the trees under observation.

Apart from the variation in peaberry, the only type of abnormality which appears to fluctuate widely from year to year is black bean. Direct investigations on this defect have not been possible during the current year, but some important studies on bean development which are

essential to the understanding of this defect have been continued.

Laboratory Studies on Fruit Development.—The material fixed and embedded last year has been under examination during the year. The work is, as yet incomplete but the main outline of the development of the coffee seed has been followed. As a recent publication has advanced views with respect to the structure of the coffee seed which is at variance with the evidence of the material studied at the Station (Houk, W. G., Science, 1936, n.s. pp. 464-5) a short note on the main points is of interest. It was found that the endosperm of the coffee seed passes through a long rest period after the process of fertilization during which there is considerable growth activity in the nucellar tissues surrounding the fertilized embryosac. These tissues develop and form a 'scaffolding' within which the true endosperm develops. The development of the latter appears to increase in rapidity from about the time when the last fruit drop occurs, and quickly replaces the whole of the developed nucellar tissues. The remnants of this latter tissue remain as the inner layer of the silver skin.

The important point with respect to black bean is that this defect is associated with disturbances in the relation between the developing endosperm and the degenerating nucellar tissues. The structural features of black bean clearly indicate that abnormal activity has occurred in the nucellar tissues which normally disappear leaving only faint traces on the inner side of the silver skin.

Observations of developing fruit have shown that it is only when the growth of the endosperm is reaching completion that any visible signs of black bean symptoms are apparent. As a rule the growth of the endosperm appears to be practically complete by the end of August after which the thickening of the cell walls to give the characteristic structure of hard endosperm takes place.

Studies on Coffee Preparation.

Fermentation.—Further work on this problem was restricted to an attempt to find the cause for the serious occurrence of foxiness in the coffee from several neighbouring estates. This defect in the coffee is by no means uncommon and causes marked reduction in the value of the product. It seems most likely that the cause of

foxiness lies in the fermentation process, though other causes cannot be entirely ruled out.

As a first step, the water supply used for pulping and washing at a number of estates, including two where foxiness had occurred, was examined for acidity. The pH obtained varied between 6·7 and 7·4 and both the estates where foxiness occurred showed a slightly acid water supply. However, the estate with the most acid water supply (6·7) did not show foxiness in the product.

Similar tests were made with the washings, samples being taken from the first wash water. Four estates where foxiness was not noted gave a pH of 4·4 to 4·6, while the estate where foxiness had been worst gave a pH of 3·6. A second estate where a certain amount of foxiness occurred gave a pH of 4·2. There is thus a suggestion that variations in the fermentation process may give rise to varying degrees of acidity in the fermenting heap.

A series of isolations of the organisms present was made from the estate showing exceptionally high acidity values and from one of estates with lower acidity values. The former showed the presence of an organism which developed a highly characteristic odour of pineapples in culture. This was absent from the cultures made from fermenting piles at the latter estate.

Experiments were made by inoculating flasks containing pulped beans with this organism, in order to test its ability to increase the acidity conditions. The results were somewhat variable but there was a general tendency to increase the acidity compared with uninoculated controls. No signs of foxiness were noted in the small samples used in these experiments.

Further work on this problem is planned for next crop season, along the following lines.

1. Attempt to produce foxiness experimentally by inoculation with the organism isolated during the current year.

2. Attempt to study the effects of increasing the acidity of the fermenting pile on the appearance of the product.

It may be noted here that the estates where foxiness occurred showed signs of a much more rapid completion of the fermentation process than those where foxiness did not occur. In one case, the coffee appeared ready for washing 24 hours after pulping.

No conclusions are yet permissible but the work indicates a line of approach to a problem which must be regarded as of very considerable importance to the industry.

Work on Nematode Worms and the Establishment of Supplies.

This work has been continued by the Assistant in Coorg and has primarily been concerned with the development of the inoculation technique noted last year. A number of separate tests of this method have established satisfactorily the ability of the nematode *Anguillulina pratensis* to invade healthy rootlets. The full details of these experiments will be reported later, but it may be said that they show that the worms breed in the roots and the decay of the rootlets sets free the eggs and young larvæ in the soil. Dissection of the stubs of roots on sickly plants at the end of the dry season showed the presence of eggs and adults in these tissues, when the soil shows no signs of worms.

Studies on the hatching of the eggs of this worm have shown that they do not hatch when kept in a moist chamber without the presence of liquid water. On the addition of water they were found to hatch quite rapidly to give the first stage larvæ.

Taking all the evidence so far accumulated, it may be said that period of activity of the worms is restricted to the wet season as far as the spread of the attack to healthy plants is concerned. It must be emphasized that the period at which the plants show signs of serious injury bears no relation to the time at which the injuries occur.

Experiments have been started to see whether it is possible to starve out the worms by isolating infected patches and keeping them free of coffee plants during the wet season. So far the species has not been found in the roots of any of the commonly occurring weeds in infested areas. It is possible that the results obtained in earlier work indicating the superiority of planting supplies towards the end of the wet season instead of at the beginning may be in part due to the local reduction in the numbers of infecting stages.

The possibilities of dilute copper sulphate solutions as local soil disinfectants are being studied. Some preliminary trials appeared promising.

White Borer Control.

The more extensive trials of Tar Distillates for the control of this pest, which were laid out last year, were examined during the current year. In this trial, the Mysore Tar Distillate supplied by the courtesy of the Mysore State Entomologist and a proprietary material Mortegg were used. The results are given in Table V.

TABLE V.

Trials of Tar Distillates for Borer Control.

		Treated	Untreated
Expt. 1 ...	Mysore Tar Distillate—		
	No. of Trees treated ...	802	676
	Borer removed ...	6	28
	Percentage ...	0·75%	4·2%
Do 2 ...	Mysore Tar Distillate—		
	No. of Trees treated .	1956	1819
	Borer removed ...	25	136
	Percentage ...	1·3%	7·5%
Do 3 ...	Mortegg 3 per cent—		
	No. of Trees treated ...	700	758
	Borer removed ...	59	82
	Percentage ...	8·4%	10·8
Do 4 ...	Mortegg 5 per cent—		
	No. of Trees treated ...	836	936
	Borer removed ...	32	68
	Percentage ...	3·8%	7·3%
Do 5 ...	Mortegg 8 per cent—		
	No. of Trees treated ...	918	980
	Borer removed ...	36	83
	Percentage ...	3·9%	8·5%

The results from the use of the Mysore Tar Distillate are very striking, but they seem very exceptional. The usual results from the use of this material in experiments in Mysore have shown results of approximately the same order as those shown for Mortegg at the five per cent and eight per cent dilutions.

The Mortegg at the two higher strengths has shown a reduction in borer removals to about a half of the

removals in parallel, untreated areas. The three per cent strength was practically valueless but there seems no advantage in increasing the concentration above five per cent. Either of these materials shows that a substantial reduction in borer removals can be obtained in badly infested areas.

Further experiments on the use of Mortegg were laid out in October and November of the current year, results from which will become available in 1937-38. These experiments were laid out to study the effect of time of application, applications being made to a series of plots between the middle of October and the end of November. At the same time, applications were made with and without the preliminary scrubbing of stems to see how far stem scrubbing was necessary for success with this treatment.

Manuring Experiment on Mature Coffee.—The harvest of the plots laid out to study the effect of manuring mature coffee was carried out as usual by the Assistant. The yields obtained in pounds of ripe cherry per plot are given in Table VI.

TABLE VI.

Yield in pounds of ripe Cherry per plot in Mature Coffee Manuring Experiment.

Treatment	1934-35	1935-36	1936-37	Mean
N. K. & Bone Meal ...	249	123	195	189
Do Preciphos ...	272	169	244	228
Do Superphos ...	263	140	190	198
Control	258	152	223	211

It is clear that there is no evident effect from the manure in this experiment. A detailed examination of the yields has shown that the variation in the individual plot yields is so large that the effects of the treatments, if any, are entirely masked. There is no indication that the yield of the control plots is falling off although the last

manurial application to these plots was made as long ago as 1932.

The most interesting feature of this experiment is the fact that the plot yields show no indications of a fixed fertility gradient in the area covered by the experiment. For the three years' yields, there is no indication of a positive correlation between the yields of the same plots in successive years. A full account of this experiment is in preparation.

Individual Yield Records.—In view of the results of the above experiment, the Assistant collected the individual yields of the trees in one of the large plots (about one acre) formerly under experiment at the Sidapur Station, with a view to studying the question of plot size and the sources of variability in plot yields. These data have not yet been fully analysed, but so far they show that by far the greater part of the variability of yield must be attributed to random causes. Further, they indicate that the possibility of getting satisfactory results from manuring or other field experiments with adult coffee are remote, as the plot size and number of replications required to reduce the error to manageable limits are so great. By the use of younger coffee all planted at one time and of less mixed origin than that of the older estates, it may be possible to reduce the sources of variability and so reduce the size of plot and number of replications required to obtain adequate results.

It is clear from the data so far collected on the question of field experimentation in coffee in South India that the problems presented are exceptionally difficult. Their solution appears to depend primarily on the provision of more even stands of coffee of similar type for experimental work.

General Notes.

The year 1936-37.—The following general notes are based primarily on the experience at the Experiment Station supplemented by occasional reports from elsewhere. They cannot be considered as at all generally applicable but may be of interest.

Following the blossom showers in March 1936, the hot weather months were rather wetter than in the preceding year and this resulted in good growth and more

rapid development of the young fruit. The South-West monsoon broke early though somewhat uncertainly but reached exceptional severity towards the end of June, and was fairly strong throughout July and August. After a short break in September, the North-East monsoon set in and was stronger than it had been in the two preceding years.

Rain was experienced rather generally in the latter part of December and some fruit drop resulted.

The dry season was rather unsatisfactory in a number of areas, rain occurring in many areas in February, though the Experiment Station escaped. Blossom showers fell at the Station in the latter part of March and were satisfactory, but elsewhere early rains resulted in partial blossoming in February.

The crop at the Station was good and on the whole the coffee remained in good heart with a good promise for the coming year. The healthy conditions of the coffee must be largely attributed to successful spraying as the unsprayed plots showed severe attacks of leaf disease in the North-East monsoon period. The success of the spray programmes must be attributed largely to rapid completion of the hot-weather growth and satisfactory spray timing. The wetter hot weather accounts for the greater severity of the disease as shown by the position in unsprayed plots.

The most significant feature of the year has been the number of reports of poor bud formation. In many cases the excellent promise of new growth in October and November was followed by extremely disappointing bud formation. It seems likely that this is to be attributed to the absence of a satisfactory rest period in the cold weather and the frequent occurrence of continued vegetative growth. In several cases examined, there were clear signs of vegetative activity resulting from December rains and this, in some cases, was further encouraged by February showers. Such vegetative activity is likely to have adverse effects on bud formation.

The outlook for the coming year cannot be considered very good as the early showers are likely to favour severe leaf disease attacks and at the same time make the problems of timing the sprays more difficult. Reports of crop promise were rather disappointing from a number of sources.

Fungus Diseases.—An interesting disease of Robusta attracted attention during the year. This was a case of

the dying-back of the tops of some young trees. In view of the existence of a very serious top disease of Robusta in Java, the material of this disease was carefully studied. The study failed to establish the presence of the typical features of the top disease as described in Java. A fungus was isolated from the deceased tissues—a species of Macrophoma—and the evidence strongly indicated this as the cause of the disease though this was not proven by inoculation experiments. The evidence further suggested that infection had occurred through scars left during suckering. Only a few cases were found of the disease during the wettest part of the South-West monsoon and no further reports of the disease were received.

It may be pointed out that cases of die-back of Robusta should be reported and specimens sent whenever they are noted, as the top disease reported from Java is a serious one and it is desirable that a careful watch should be kept for it.

The death of large numbers of newly planted basket plants put on an estate was investigated. This was at first thought to be a fungus disease but the investigation, while it failed to establish with certainty the cause, showed that the deaths were due to an injury at the collar which must have occurred in the nursery. As long as the plants were under the sheltered conditions of the nursery, they could obtain a sufficient water supply past the injury but under the severer conditions in the field after the cessation of the rains, they wilted. It was impossible to determine the cause of the injury.

No other new diseases were reported during the year.

Insect Pests.—Sucking insects were rather less noticeable at the Station during the year. This is probably attributable to the wetter conditions in the hot weather. The tests on insecticides noted last year were continued as long as satisfactory material of the bug was available. Two proprietary mineral oils were tested in comparison with 2 per cent Honge Oil Resin Soap. They showed results fully comparable with the Soap. Attempts were then made to use one of the mineral oil emulsions in combination with Bordeaux. The results showed some success but the mortality of the bugs was lower than with the mineral oil alone. The data from one experiment are given in Table VII.

TABLE VII.

Insecticides for Green Bug.	*Percentage of Mortality.*
2% Honge oil Resin Soap ...	... 86·3
1% Mineral Oil Emulsion ...	... 86·1
2% Honge Oil Resin Soap ...	... 92·9
1% Mineral Oil Emulsion in ½% Bordeaux	... 69·1

The data were obtained from counts on young coffee shoots, about 800—1,000 adult bugs being used.

The year was a severe one for borer, the cumulative effect of two consecutive years of poor north-east rains being undoubtedly responsible for the very widespread serious damage done by this pest in the current year. Work on the control of this pest has already been dealt with.

Correspondence—Publications.

Enquiries have been dealt with as usual during the year. The more outstanding problems dealt with during the year have been concerned with the importance of manuring to coffee crop production with a view to revising budgets where possible on account of slump conditions. Enquiries with respect to spraying, more especially with reference to the timing of sprays, still bulk largely in the enquiries received.

No new bulletins were published during the year. A bulletin which has been in preparation for some time was sent to press at the end of the year.

A spray warning was sent to the "Planters' Chronicle" in connection with spray programmes in the hot weather of 1937.

A large number of samples of coffee have been examined for the Marketing Officer, with respect to their physical characters and grading. This was completed at the end of the year.

Acknowledgments.

It is once more a pleasure to express my appreciation of the cordial co-operation and assistance that I have received from the Director and Staff of the Mysore Department of Agriculture throughout the year. I am also glad to express my thanks to the many planters who,

at various times, have assisted me with hospitality, suggestions and assistance in experimental work.

Mr. Subramanyam, though handicapped by the bad health conditions at Sidapur, has been responsible for a great deal of useful work. Progress with his special problem is difficult and slow but progress is being made.

W. WILSON MAYNE,
Coffee Scientific Officer,
U. P. A. S. I.

ENGLAND,
30*th June* 1937.

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